Application for New Course

1. Submitted by the College of Engineering
   Date: August 1, 2000
   Department/Division offering the course: Computer Science

2. Proposed designation and Bulletin description of this course:
   (a) Prefix & Number: 673
   (b) Full Title: Error Correcting Codes
      Abbreviated Title (≤ 24 characters): Error Correcting Codes
   (c) Lecture/Discussion hours per week: 3
   (d) Laboratory hours per week: 0
   (e) Studio hours per week: 0
   (f) Credits: 3
   (g) Course description:
      The problem of correct transmission of data in a noisy environment. The design and
      analysis of codes that efficiently (in terms of data rate and encryption and decryption
      speed) correct errors. Linear and nonlinear block codes, general encoding and decoding
      techniques, fundamental bounds, dual codes, cyclic codes. Specific codes will be studied,
      including Hamming, BCH, Reed-Muller, Reed-Solomon, trellis, and convolutional codes.
   (h) Prerequisites (if any): CS-515 or consent of the instructor.
   (i) May be repeated to a maximum of: N/A

3. To be cross listed as: N/A
   Signature of cross-listing chair: ____________________________

5. Effective date: Fall 2001

6. Course to be offered: Fall Spring Summer
   X

7. Will the course be offered annually; explain if not: Yes

8. Why is the course needed? Most communication media are prone to errors. Despite
   errors, data must be received reliably. In general this is accomplished by replication of
   data, leading to a loss of bandwidth. This course studies techniques that limit the loss of
   bandwidth while allowing efficient encoding and decoding of data. It develops
   mathematical tools for the design and development of modern communication systems,
   that people with knowledge of these subjects be available.

9. (a) By whom will the course be taught? Andrew Klapper
    (b) Are facilities for teaching this course now available? Yes
       If not, what plans have been made for providing them?

10. What enrollment may reasonably be expected? 10
11. Will this course serve students in the Department primarily? Yes
Will it be of service to a significant number students outside the Department? No
If yes, under what area?

12. Check the category most applicable to this course:
   - traditional; offered in corresponding departments elsewhere;
   - relatively new, now being widely established;
   - not yet found in many (or any) other universities

13. Is this course part of a new proposed program? No
If yes, which?

14. Will adding this course change the degree requirements in any programs? No
If yes, explain:

15. Attach a list of the major teaching objectives of the proposed course and outline
    and/or a reference list to be used: See attached

16. If the course is a 100-200 level course, please submit evidence (e.g., correspondence)
    that the Community College System has been consulted.
    not applicable

17. Within the Department, who should be contacted for further information about the
    proposed course?
    Name: Andrew Klapper Phone: 257-6743

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1Approval of this course will constitute approval of the program change unless other program modifications are proposed.
Signatures of Approval:

Department Chair: [Signature] Date: 11/14/2000
Dean of the College: [Signature] Date: 2/8/01
Date of Notice to the Faculty: 1/26/01

Undergraduate Council^2: __________________________ Date: ______
University Studies^2: __________________________ Date: ________
Graduate Council^2: [Signature] Date: 3/27/01
Senate Council^2: __________________________ Date: ________
Date of Notice to the University Senate: _______

Action other than approval: __________________________

^2If applicable, as provided by the Rules of the University Senate
**Needed Skills**
Students must have a solid background in discrete mathematics (CS275) and algorithm design and analysis (CS515).

**Learning Outcomes**
Successful students will learn:
- Basic issues of communication in a noisy environment
- Basic approaches to error correction
- Mathematical tools for analyzing and designing error correcting codes, including the theory of finite fields
- Fundamental limits of error correction
- The background needed to read the current literature in coding theory

**Week by Week Course Outline**

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<tr>
<th>Week</th>
<th>Activities</th>
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<td>1-2</td>
<td>Introduction and linear codes</td>
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<td>3</td>
<td>Hamming codes and basic constructions</td>
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<td>4-5</td>
<td>Finite fields and double error correcting BCH codes</td>
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<td>6-7</td>
<td>Dual codes and cyclic codes</td>
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<td>Multiple error correcting BCH codes</td>
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<td>Reed-Solomon codes</td>
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<td>10-11</td>
<td>Reed-Muller codes</td>
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<td>12-13</td>
<td>Trellis and convolutional codes</td>
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<td>14-15</td>
<td>Student talks</td>
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**Graded work**
Exact details about graded work in this course will be determined by the instructor offering the course and will be made available in the syllabus during the first class meeting. Typically there will be a presentation of a paper in the recent literature by each student, bi-weekly homework, and a two-hour final examination.

**Grading**
A student's grade will be determined by a weighted average of homework assignments, presentation, and the final examination. The faculty offering the course will make the details available at the start of the course. A typical weighting is:

Homeworks: 40%
Paper presentation: 25%
Final Examination: 35%

**Possible Textbooks**